

# Bile Duct Injury After Single Incision Laparoscopic Cholecystectomy

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## ABSTRACT

**Background:** The advancement and development of laparoscopic cholecystectomy revolutionized surgery and case management. Many procedures are routinely performed laparoscopically. Single incision laparoscopic surgery has been introduced with the hope of further reduction of scarring and possibly procedural pain. With no established technique for this procedure, the safety of single incision laparoscopic cholecystectomy has not been determined.

**Methods and Results:** A 30-year-old man underwent single incision laparoscopic cholecystectomy for symptomatic cholelithiasis at an outside hospital. The operation was uneventful, and the patient was discharged home. The patient returned to the Emergency Department 4 days postoperatively, and a bile duct injury was diagnosed. A percutaneous drain was placed, and the patient was transferred to the Hepato-Pancreato-Biliary (HPB) service of a tertiary care center for definitive care. A delayed repair approach was used to allow the inflammation around the porta to decrease. Six weeks after injury, the patient underwent Roux-en-Y hepaticojejunostomy. The patient did well postoperatively.

**Conclusion:** Although single incision laparoscopic surgery will play a prominent role in the future, its development and application are not without risks as demonstrated from this case. It is imperative that surgeons better define the surgical approach to achieve the critical view and select appropriate patients for single incision laparoscopic cholecystectomy.

**Key Words:** Single incision laparoscopic cholecystectomy, Bile duct injury.

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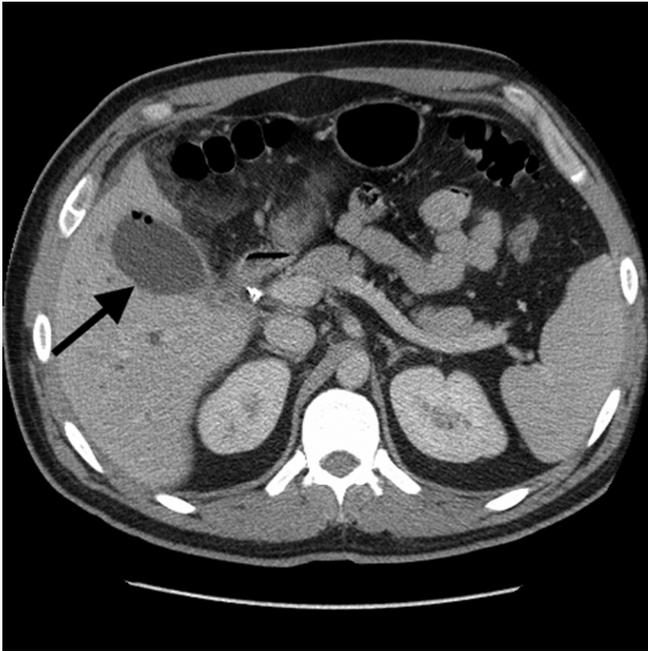
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## INTRODUCTION

The advancement and development of laparoscopic cholecystectomy revolutionized surgery and case management. Many procedures, such as adrenalectomy, colectomy, hernia repair, and cholecystectomy are routinely performed laparoscopically. Open cholecystectomy has been largely replaced by laparoscopic cholecystectomy since the first reported case in 1987.<sup>1</sup> As technologies evolve, surgeons continue to improve perioperative patient outcomes by introducing various methods to reduce port size and number. This pursuit of “scarless” surgery has given rise to the concept of Natural Orifice Transluminal Surgery (NOTES) and single incision laparoscopic surgery. These approaches might offer significant advantages for minimizing procedural pain and eliminating or minimizing postoperative scars, while maintaining the same safety profiles and cost effectiveness. While the current standard approach for cholecystectomy is laparoscopic cholecystectomy by a multi-port minimally invasive technique, scattered series in the literature have also described the early experiences of patients undergoing single incision for cholecystectomy.<sup>2–8</sup> Although it is premature to determine the complication rate from single incision laparoscopic cholecystectomy due to the small number of reported cases, one report suggests that the complication rate may be as high as 16.6%.<sup>9</sup> However, in contrast to laparoscopic cholecystectomy, no significant injury involving the porta hepatis has been reported following a single incision laparoscopic cholecystectomy. We report the first bile duct injury from single incision laparoscopic cholecystectomy.

## CASE REPORT

The patient is a 30-year-old man who underwent single incision laparoscopic cholecystectomy at an outside hospital. The patient's operation was reportedly uncomplicated, and the patient was discharged the same day. The patient developed abdominal pain and fever on postoperative day 4 and sought medical attention. Technetium-99m dimethyl acetanilide iminodiacetic acid hepatobiliary (HIDA) scan demonstrated a biliary leak. The patient's management included a computed tomography (CT), percutaneous drainage of biloma (**Figure 1**), and an endoscopic retrograde cholangio-



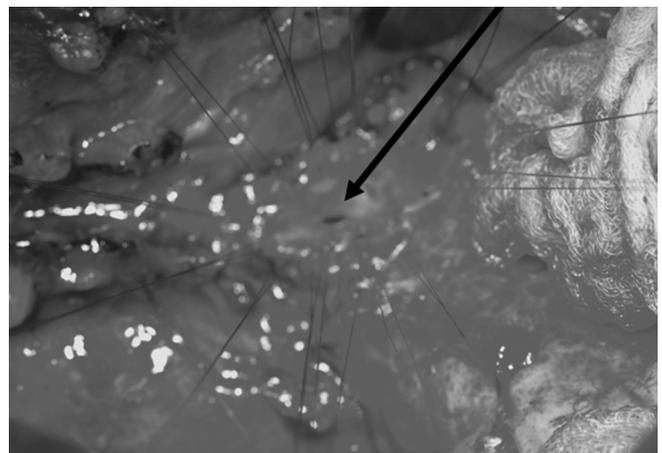
**Figure 1.** Computed tomography showing a subhepatic biloma (arrow).



**Figure 2.** Ligation of distal common bile duct with no filling of the proximal common bile duct. Clip at the common bile duct (arrow).

pancreatography (ERCP). The CT revealed diminution of enhancement throughout the right lobe of the liver, and this finding was consistent with a right hepatic artery ligation. An ERCP demonstrated complete occlusion of the common bile duct with no communication to the proximal intrahepatic ductal system (**Figure 2**). The percutaneous drain continued to drain bile, and the patient was transferred to the HPB service of a tertiary care center for definitive treatment of a common bile duct injury.

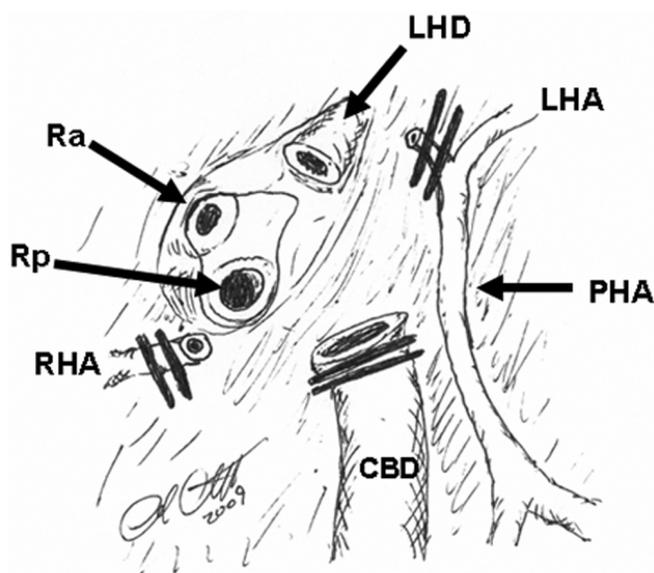
A delayed repair approach was chosen to allow the inflammatory tissue involving the porta to decrease and delayed biliary injury to manifest due to vascular compromise. Six weeks after the injury, the patient was explored. Intraoperatively, the injury was identified at the hilus of the liver. The common bile duct was divided at the confluence of the left and right hepatic ducts, and the distal duct was clip ligated. The left hepatic duct was opened transversely through the confluence (**Figures 3 and 4**). The right anterior sector and the right posterior sector ducts were then identified with coronary probes. The right posterior sector duct was identified as the dominant branch. A handsewn end-to-side hepaticojejunostomy was performed in an interrupted fashion with 5-0 PDS suture. The patient had an uneventful postoperative course and was discharged home on postoperative day 5.



**Figure 3.** Intraoperative picture of the porta hepatis showing transection of the bile ducts at their confluence (arrow).

## DISCUSSION

It is well established that conventional laparoscopic cholecystectomy following the guideline of critical view results in major bile duct or vessels injury in <1% of patients (range, 0.3 to 0.95) with other complications <3%.<sup>10-13</sup> The relative safety associated with laparoscopic cholecystectomy has led to its acceptance as the gold standard for cholecystectomy. Significant factors contributing to the



**Figure 4.** Schematic of the bile duct injury, CBD=common bile duct, PHA=proper hepatic artery, LHA=left hepatic artery, LHD=left hepatic duct, Ra=right anterior duct, Rp=right posterior duct, RHA=right hepatic artery.

safety may be standardized technique involving careful dissection of the triangle of Calot with development of the critical view of safety, experience with laparoscopic cholecystectomy and other laparoscopic procedures, improvement in the laparoscopic instruments,<sup>14</sup> and routine use of cholangiography.

Since the introduction of laparoscopic cholecystectomy, the evolution of minimally invasive techniques has continued the search for a less invasive and painful procedure with an emphasis on decreasing the number, size, or both number and size, of the trocars. This has subsequently led to the development of a single, commercially available, multi-instrument plastic cylinder. The single incision laparoscopic port is usually inserted through a small umbilical incision and provides excellent postoperative cosmesis.<sup>15</sup> However, cosmesis alone may not be sufficient to justify the potential operative risks from single incision laparoscopic cholecystectomy. Others have suggested that patients may have less postoperative pain from single incision laparoscopic surgery. No data currently exist comparing postoperative pain from single incision laparoscopic cholecystectomy with that of conventional laparoscopic cholecystectomy. Port reduction strategies have previously led to the development of a minilaparoscopic approach, where minilaparoscopy is defined as 2-port laparoscopic surgery with a standard size umbilical port and a 2-mm, lateral mini-port. A metaanalysis comparing

minilaparoscopic cholecystectomy with conventional laparoscopic cholecystectomy failed to demonstrate significant improvements in surgical outcomes, including pain.<sup>16</sup> Such data for single incision laparoscopic cholecystectomy are currently lacking.

Recently, Chamberlain et al<sup>17</sup> performed a comprehensive review of case series using single incision laparoscopic cholecystectomy. Of the reported cases, 142 cholecystectomies were attempted by single incision laparoscopic technique; 130 of these cholecystectomies were completed.<sup>8,9,18–25</sup> Ten operations were converted to open cases due to difficult dissection or cystic artery hemorrhage. The majority of the patients were highly selected young people with cholelithiasis. Minor complications including subcutaneous hematoma and bile leak were reported with the complication rate ranging from 0% to 16%.<sup>9</sup> No major bile duct injury was reported in this study.

The experience transitioning from open cholecystectomy to laparoscopic cholecystectomy has taught us that a minimum of 12 cases is necessary to decrease the complication rate for laparoscopic cholecystectomy.<sup>26</sup> Similarly, the initial learning curve may result in an increased complication rate for single incision laparoscopic cholecystectomy. The minimum number for single incision laparoscopic procedures has yet to be determined. Since most surgeons performing single incision laparoscopic cholecystectomy are trained in laparoscopic cholecystectomy, their experience may translate to safer dissection of the Calot's triangle and hence a reduced learning curve.

A root cause analysis of the causes of bile duct injury from laparoscopic cholecystectomy and identified 3 main factors contributing to injury.<sup>11,27,28</sup> Interestingly, the majority of the injuries were attributed to the surgeons' misperception of the anatomy of the cystic duct and gallbladder. It appears that most injuries are not secondary to inadequate skills or fund of knowledge. A similar approach should be applied to single incision laparoscopic cholecystectomy to ensure surgeons can transfer the mental anatomic model from laparoscopic cholecystectomy to single incision laparoscopic cholecystectomy and be vigilant before dividing the cystic duct and artery.

Intraoperative cholangiography is another tool that may assist in identifying the biliary anatomy during difficult dissection, and it may be helpful to decrease the incidence of bile duct injury in laparoscopic cholecystectomy.<sup>29</sup> Surgeons who perform single incision laparoscopic cholecystectomy should be experienced in performing and interpreting cholangiograms, because misinterpretation of the images is common.<sup>30</sup> A single incision laparoscopic cho-

lecyctectomy may need to be converted to a laparoscopic cholecystectomy, if not open, when the operation is complicated by uncertain anatomy or when bile duct injury is suspected.

Regardless of the approach used to remove the gallbladder, the most reliable technique to prevent bile duct injury is to obtain the critical view of safety. This entails dissecting Calot's triangle free of all tissue except the cystic duct and artery, with the base of the liver bed exposed. Although single incision laparoscopic cholecystectomy is limited by restricted movements, difficulty to achieve triangulation, poor visibility as a result of lack of smoke evacuation, and inability to change the camera angle, this very same standard should apply. If there is lack of progression during the procedure due to anatomical variants or inadequate retraction via a single incision, the surgeon should convert to a 4-port or open cholecystectomy. If the patient has acute or chronic inflammation, a large stone in the pouch of Hartmann, adhesive bands between the gallbladder and common hepatic duct or intrahepatic gallbladder, Calot's triangle could be obliterated. This may render dissection dangerous. A safe and acceptable strategy would be to abort the procedure, place a drain and transfer the patient to a center with extensive hepatobiliary expertise.<sup>27</sup> We advocate not using the infundibular technique, which involves clearing only the tissue around the cystic duct/CBD junction, which has a higher likelihood of misidentification injury especially during single incision laparoscopic cholecystectomy.

Single incision cholecystectomy represents a surgical innovation that is developing so fast that its clinical validation is lacking. Traditionally, many surgical procedures were developed on a trial and error basis. This may raise concern for patient safety. A framework to evaluate the safety of new procedures is necessary to protect patients; however, the framework must also be flexible so as not to obstruct improvement in surgical technique.<sup>31</sup> Surgeons involved in improving surgical procedures must have a thorough understanding of how various approaches work to minimize patients' risks. Ideally, the safety data for a new technique should not be based on case series alone but should be evaluated in a randomized controlled fashion. An online database should be created for single incision cholecystectomy, perhaps similar to the one created by the Natural Orifice Surgery Consortium for Assessment and Research (NOSCAR) group, with all cases recorded in a registry.<sup>32</sup> It will allow critical evaluation of outcomes of patients undergoing single incision cholecystectomy and may facilitate standardization of outcome comparisons.

While single incision laparoscopic cholecystectomy may play an important role in the future of minimally invasive surgery, its development and application is not without risks as demonstrated by this case report. It is imperative that surgeons better define the surgical approach to achieve the critical view of safety and select the appropriate patients. Combined with further advances in single incision laparoscopic instrumentation, such as articulating instruments and flexible laparoscopes, the clinical outcome for single incision laparoscopic cholecystectomy can be expected to improve. The safety profile for single incision laparoscopic cholecystectomy requires further prospective study to compare standard laparoscopic cholecystectomy with single incision laparoscopic cholecystectomy.

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